WHAT IS CLAIMED IS:

1. A method comprising:

converting a low molecular weight sugar to a product, utilizing a microorganism and/or an enzyme that is immobilized on biomass material.

2. The method of claim 1 wherein the biomass material comprises functionalized biomass fibers.

3. The method of claim 1 or 2 wherein converting comprises allowing the microorganism to convert at least a portion of the low molecular weight sugar to a hydrocarbon, alcohol, or hydrogen.

4. The method of claim 3 wherein the alcohol comprises ethanol.

5. The method of any of the above claims wherein the microorganism comprises a yeast.

6. The method of claim 5 wherein the yeast is selected from the group consisting of S. cerevisiae and P. stipitis.

7. The method of any of the above claims wherein the microorganism comprises a bacterium.

8. The method of claim 7 wherein the bacterium comprises Zymomonas mobilis.

9. The method of claim 2 further comprising irradiating biomass fibers to produce the functionalized biomass fibers.

10. The method of claim 9 wherein irradiating comprises irradiating with ionizing radiation.

11. The method of claim 9 wherein irradiating is performed using a particle beam.

12. The method of any of the above claims wherein the biomass material comprises a cellulosic or lignocellulosic material.

13. The method of claim 2 wherein the biomass fibers have a BET surface area of greater than 0.25 m^2/g.

14. The method of any of the above claims wherein converting comprises fermentation.

15. The method of claim 2, wherein the biomass fibers are derived from biomass selected from the group consisting of paper, paper products, paper waste, wood, particle board, sawdust, agricultural waste, sewage, silage, grasses, rice hulls, bagasse, jute, hemp, flax, bamboo, sisal, abaca, straw, corn cobs, corn stover, switchgrass, alfalfa, hay, coconut hair, cotton, seaweed, algae, and mixtures thereof.

16. The method of claim 2 wherein the biomass fibers are derived from a biomass feedstock that has internal fibers, and that has been sheared to an extent that its internal fibers are substantially exposed.

17. The method of claim 2 wherein the biomass fibers have a porosity greater than 70%.

18. The method of any of the above claims wherein the converting step exhibits a % performance of at least 140%.

19. The method of claim 2 further comprising recovering the biomass fibers after conversion and reusing the fibers in a second, subsequent conversion process.

20. The method of claim 2 wherein the biomass fibers are provided in the form of a single or multi-layer sheet.

21. The method of claim 2 wherein the biomass fibers are provided in the form of a fibrous material that is overlaid, folded, or in the form of a screen or mesh.

22. The method of claim 2 wherein the biomass fibers are extruded or coextruded.

23. The method of claim 2 wherein the fibers have a nano-scale average particle size.

24. The method of any of the above claims wherein converting comprises introducing the low molecular weight sugar and biomass to a liquid medium, and the method further comprises pretreating the fibers or a fibrous material containing the fibers with a microorganism and/or enzyme prior to introducing the fibers or materials to the medium.

25. A mixture comprising:
a biomass material having polar functional groups,
a microorganism and/or enzyme having complementary functional groups, and
a liquid medium.

26. A composition comprising biomass fibers and a microorganism and/or enzyme immobilized on the biomass fibers.

27. The composition of claim 26 wherein the fibers have functional groups, and the microorganism and/or enzyme has complementary functional groups.

WHAT IS CLAIMED IS:

1. A method for fermenting a low molecular weight sugar to a product comprising: contacting a low molecular weight sugar, in a medium, with a sheet comprising oxidized biomass fibers and a fermenting microorganism immobilized on the fibers; and fermenting the low molecular weight sugar under conditions suitable for converting said sugar to a product by the fermenting microorganism; wherein the biomass fibers have been oxidized in an oxidizing medium by a method selected from the group consisting of about 5 to 60 Mrad radiation, chemical oxidation, sonication and pyrolysis.

2. The method of claim 1 wherein fermenting converts at least a portion of the low molecular weight sugar to a hydrocarbon, an alcohol, or hydrogen.

3. The method of claim 2 wherein the alcohol is ethanol.

4. The method of claim 1 wherein the microorganism is a yeast.

5. The method of claim 4 wherein the yeast is selected from the group consisting of *S. cerevisiae* and *P. stipitis*.

6. The method of claim 1 wherein the microorganism is a bacterium.

7. The method of claim 6 wherein the bacterium comprises *Zymomonas mobilis*.

8. The method of claim 1 wherein the fibers have been oxidized in an oxidizing environment by irradiating with ionizing radiation.

9. The method of claim 8 wherein irradiating is performed using a particle beam.

10. The method of claim 1 wherein the biomass fibers comprise a cellulosic or lignocellulosic material.

11. The method of claim 1 wherein the biomass fibers have a BET surface area of greater than 0.25 m^2/g.

12. The method of claim 1, wherein the biomass fibers are derived from biomass selected from the group consisting of paper, paper products, paper waste, wood, particle board, sawdust, agricultural waste, sewage, silage, grasses, rice hulls, bagasse, jute, hemp, flax, bamboo, sisal, abaca, straw, corn cobs, corn stover, switchgrass, alfalfa, hay, coconut hair, cotton, seaweed, algae, and mixtures thereof.

13. The method of claim 1 wherein the biomass fibers are derived from a biomass feedstock that has internal fibers, and that has been sheared to an extent that its internal fibers are substantially exposed.

14. The method of claim 1 wherein the biomass fibers have a porosity greater than 70%.

15. The method of claim 1 further comprising recovering the biomass fibers after fermenting and reusing the fibers in a second, subsequent fermentation process.

16. The method of claim 1 wherein the sheet is a multi-layer sheet.

17. The method of claim 1 wherein the sheet is overlaid, folded, or in the form of a screen or mesh.

18. The method of claim 1 wherein the biomass fibers are extruded or coextruded.

19. The method of claim 1 wherein the fibers have a nano-scale average particle size.

20. A method for fermenting a low molecular weight sugar to a product comprising: contacting a low molecular weight sugar, in a medium, with a sheet consisting essentially of oxidized biomass fibers and a fermenting microorganism immobilized on the fibers; and fermenting the low molecular weight sugar under conditions suitable for converting said

sugar to a product by the fermenting microorganism; wherein the biomass fibers have been oxidized in an oxidizing environment by a method selected from the group consisting of about 5 to 60 Mrad radiation chemical, oxidation, sonication and pyrolysis.

21. The method of claim 20 wherein the oxidized fibers have been oxidized in an oxidizing environment by irradiating with ionizing radiation.

22. The method of claim 21 wherein irradiating is performed using a particle beam.